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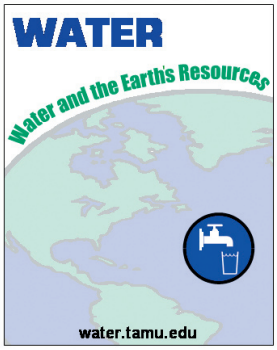


# Drinking Water Problems: MTBE

Monty Dozier and Bruce Lesikar*

Methyl tertiary-butyl ether, commonly called MTBE, is a common gasoline additive that reduces air pollution. However, it has been found to contaminate ground water. Long-term exposure to this additive has been found to cause serious health problems in laboratory rats and mice; research has not yet verified whether or not long-term exposure is harmful to people.

MTBE is a volatile, flammable, colorless, organic, liquid compound that dissolves easily in water and is used as a gasoline additive. This compound belongs to a chemical family of fuel oxygenates that enhance gasoline combustion by increasing oxygen available for the process. Added to gasoline, MTBE has reduced carbon monoxide and ozone emissions by promoting more complete burning of gasoline. This has made the use of MTBE very popular in areas that do not meet National Ambient Air Quality Standards.

In the Clean Air Act of 1990, Congress mandated the use of reformulated gasoline in areas of the United States with the worst ozone or smog problems. Reformulated gasoline must meet technical specifications established by the Clean Air Act, including a specific oxygen content. MTBE and ethanol are the primary oxygenates used to meet this requirement. According to the U.S. Environmental Protection Agency (EPA) as of December 1997, the most common fuel oxygenate used in the U.S. is MTBE. This additive accounts for more than 80 percent of reformulated gasoline supplies. Thirty-two areas in 18 states are participating in this program. The use of this fuel has significantly improved air quality; unfortunately, studies have detected MTBE in ground and surface water.

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## How Does MTBE Contaminate Water Supplies?

Contamination of water may come from fuel storage tanks and pipelines, including those associated with the production and use of gasoline. Accidental spills from railroad tank cars and over-the-road tractor trailers can also contaminate surface and ground water supplies.

Emissions from boats and other marine engines in Texas waterways can contaminate water with MTBE, as can gasoline storage and supply facilities located on the water at docks and marinas. MTBE may also contaminate surface water through the air by rainfall deposition.

MTBE is a greater risk in ground water than in surface water. Because MTBE dissolves easily in water and has a small molecular size, it migrates faster and farther in the ground than other gasoline components. MTBE does not biodegrade easily and is difficult and costly to remove from groundwater. However, in surface water MTBE is removed relatively quickly through the process of volatization (evaporation).

## Occurrence of MTBE

The U.S. Geological Survey has detected MTBE in groundwater in 24 states. However, any location where gasoline is used, transported or stored is susceptible to contamination. The U.S. Geological Survey detected

MTBE in water about five times more often, and at higher concentrations, in areas of the country where the additive has been used to reduce air pollution.

The Texas Commission on Environmental Quality has also reported locations of Texas groundwater containing MTBE (Fig. 1).

**Texas Groundwater Contamination Map for MTBE***

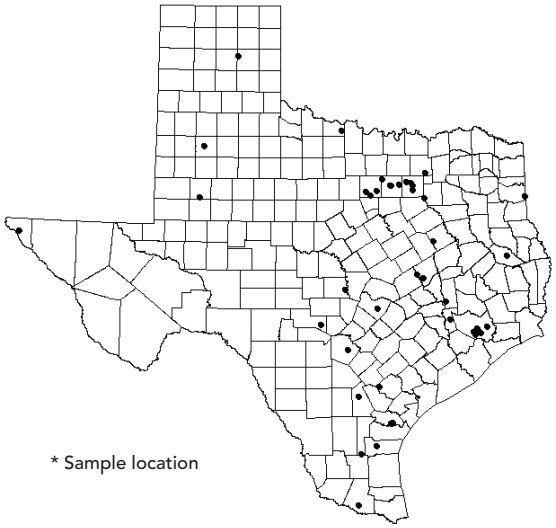


**Figure 1: Occurrence of MTBE in Texas Groundwater (Source: Joint Groundwater Monitoring and Contamination Report, 2006). http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/sfr/056_06_index.html**

## What are the Potential Health Effects of MTBE?

Little research has been conducted on human health effects associated with MTBE in drinking water. However, immediate or acute symptoms may include nausea, dizziness, shortness of breath and diarrhea. Research also has shown that MTBE ingested by humans and animals is metabolized or eliminated from the body within hours. The EPA evaluates new information as research on ingestion of the additive continues.

In laboratory rats, long-time exposure to MTBE has been found to cause gastrointestinal irritation, cancer and damage to liver, kidneys and nervous system. Evidence of human cancer or nervous system effects from consuming or bathing in MTBE-contaminated water remains inconclusive.

The EPA has not yet established a national drinking water standard for MTBE. In 2005, the additive was placed on the agency's drinking water Contaminant Candidate List. The drinking water contaminant list is used to determine research that will affect regulatory decision making for contaminants such as MTBE. Contaminants on this list are known or anticipated to be found in public water systems and are currently not covered by national primary drinking water regulations.

Despite the lack of national regulations on MTBE, the EPA issued a drinking water advisory for the additive based on how it affects the taste and odor of drinking water. The national advisory is 20 to 40 micrograms per liter (µg/L); human exposure to MTBE in this range is 20,000 to 100,000 times lower than the equivalent exposure rate for laboratory rats and mice. Human health could be affected by drinking MTBE-contaminated water at levels above 225 micrograms per liter.

Several states—including California, New York and Michigan—have established primary drinking water standards for MTBE. Texas follows the EPA drinking water advisory of 20 to 40 micrograms per liter.

## How can MTBE be Removed from Well Water?

MTBE requires a specific treatment process for removal from water. Well owners can use granular activated carbon or charcoal to remove MTBE from their water. Activated carbon filters have been used to improve the taste or remove odor of the water, although undesirable tastes and odors are not necessarily unhealthy. Granular activated carbon filters can remove organic compounds such as volatile organic compounds, pesticides and benzene, and can also remove some metals, chlorine and radon. A typical water softener will not remove MTBE from water.

Home granular activated carbon filtering systems are usually simple. The activated charcoal is packaged in filter cartridges inserted into a purification device (Fig.2). Drinking water passes through the cartridge on its way from the source to the faucet. These filters

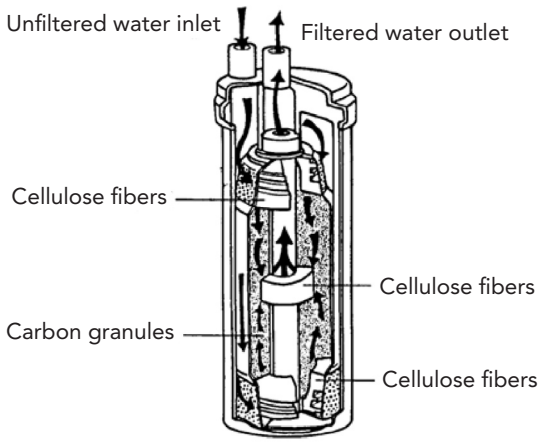


**Figure 2: Granular activated carbon (GAC) filter (adapted from Parrott et al).**

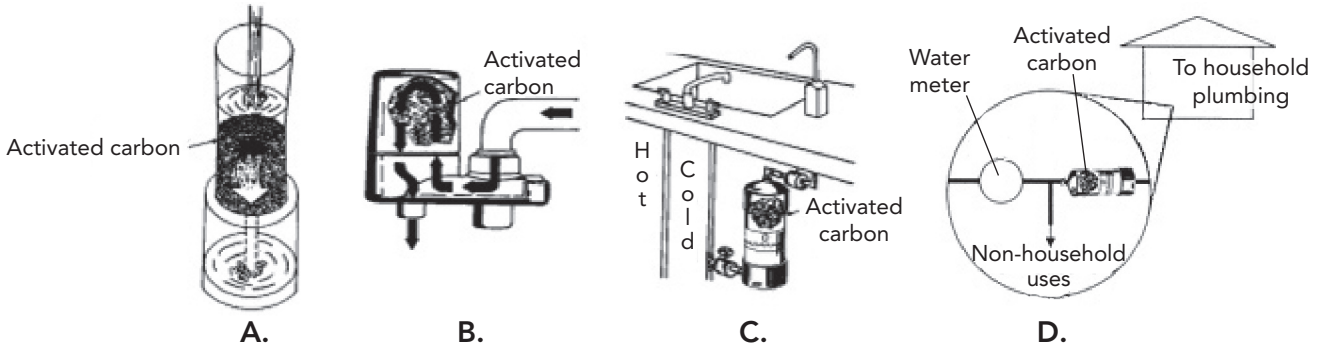


**Figure 3. Four types of activated carbon filtration units are, from left: A) pour-through; B) faucet-mounted; C) high-volume and D) point-of-entry. (adapted from Kocker et al).**

eventually lose their ability to adsorb contaminants and must be replaced.

In the home, granular activated carbon filtering systems are usually installed where the treated water will be used for drinking or cooking. Treatment systems can be placed directly on the faucet, on the countertop or under the sink (Fig. 3). Most systems contain a bypass so water used for purposes other than drinking and cooking may be dispensed without being treated, thus extending the life of the filters.

Filters for home water treatment contain either granular activated charcoal or powdered block charcoal. The amount of material in a filter affects the amount and rate of contaminant it removes. More granular activated carbon in a filter means more contaminant removal, longer filter life, fewer filter cartridge changes and less chance of drinking contaminated water.

Particle size may also affect contaminant removal rate, with smaller activated charcoal particles having higher adsorption rates. Rust, scale, sand and other sediments can clog filters and reduce removal capacity and treatment life. Foam or cotton fiber pretreatment filters can be used to remove such particulates. However, filters will become clogged over time and will require replacement.

## How Should a Water Well Owner Select a Treatment Unit?

No single technology will treat all water contaminants. Before a treatment option is selected, have the water tested by a qualified laboratory. A list of labs certified by the Texas Commission on Environmental Quality can be found at http://www.tceq.state.tx.us/assets/public/compliance/compliance_support/qa/sdwa_lab_list.pdf .

After the water has been tested to determine what contaminants it contains, research different products to find one suitable for treating your water supply. Take note of the system's co-treatment compatibility if more than one contaminant is to be treated. Compare different systems' costs and requirements, as well as contaminant removal efficiency, warranties, life expectancy of the system and the reputation of the company. Also consider the wastewater or solid waste that the system will generate.

Home treatment systems are not regulated by federal or state laws. However, some national organizations offer certification of products. The Water Quality Association (www.wqa.org) offers a validation program and advertising guidelines. Products that receive the association's Gold Seal Product Validation are certified in mechanical performance but not in their ability to remove harmful contaminants.

The NSF International (www.nsf.org) certifies a product's ability to remove contaminants that affect health. A list of drinking water treatment units that have the foundation's certification can be found at: http://www.nsf.org/Certified/DWTU/ . To ask about certification of a particular product contact the foundation's Consumer Hotline at 800-NSF-MARK (800-673-6275) or e-mail to info@nsf.org , or write to NSF International, P.O. Box 130140, 789 North Dixboro Road, Ann Arbor, MI 48113-0140. An EPA registration number indicates that the unit is registered with the EPA but does not imply the agency's approval or certification.

## How Can Water Well Owners Keep their Systems Working?

No matter what treatment technology is being used, maintenance will be required to keep the system operating properly. The first step to proper operation and maintenance is proper installation. Qualified installers:

- Carry liability insurance for property damage during installation
- Are accessible for service calls
- Accept responsibility for minor adjustments after installation
- Give a valid estimate of the cost of installation

After system installation, the treatment unit will need to be maintained properly. Refer to the system's manual for maintenance details.

All systems should be operated according to the manufacturers' specifications. Treating more water than the system is designed for may lower the effectiveness of the treatment and reduce the quality of the water. Water from the treatment units should be tested regularly to ensure proper operation of the system.

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## Acknowledgement


Guidance and assistance was provided by the Texas Groundwater Protection Committee and the Texas Commission on Environmental Quality.


Texas Water Resources Institute
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This publication was partially funded by a grant from the U.S. Environmental Protection Agency administered by Texas Commission on Environmental Quality and funds associated with the Rio Grande Basin Initiative administered by the Texas Water Resources Institute of the Texas AgriLife Extension Service, with funds provided through a grant from the Cooperative State Research, Education and Extension Service, U.S. Department of Agriculture.

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